

SCIENCE

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THE CHEROKEES IN PRE-COLUMBIAN TIMES.

V.

THE close agreement between the testimony of the mounds and the traditions of both Cherokees and Delawares is somewhat remarkable, and justifies us in believing that they have a basis of truth. We are at least warranted in accepting the theory that the first-named people formerly dwelt in Ohio, and built some of the noted monuments of that State. The number and character of the defensive works indicate that there was a long contest and an obstinate resistance on the part of the original inhabitants. The geographical position of these works makes it apparent, as has often been remarked by writers on this subject, that there was a pressure by northern hordes which finally resulted in driving the inhabitants of the fertile valleys of the Scioto and Muskingum southward. Some of these writers take it for granted that they fled through Kentucky and Tennessee into the Gulf

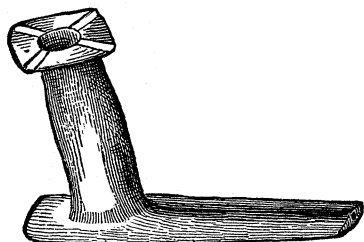


FIG. 10.

States, and became incorporated with the tribes of that section. If this be assumed as correct, it only tends to confirm the theory of an Indian origin.

A study, however, of the pipes alone, makes it evident that this conclusion cannot be maintained. That the mound-builders of Ohio made and used pipes is proven by the large number found in the tumuli, and that they cultivated tobacco may reasonably be inferred from this fact. Although varied indefinitely by the addition of animal and other figures, the typical or simple form in use among them appears to have been that known at present as the "Monitor" pipe, shown in Fig. 68, "Ancient Monuments," and Fig. 177, Rau's "Archæological Collection of the National Museum." The peculiar feature is the broad, flat, and slightly curved base or stem, which projects in front of the bowl to an extent equal to the perforated end. This form is so peculiar that it must be considered ethnic or local. However, as will be seen by reference to the "Proceedings of the Davenport Academy of Natural Sciences" and the "Smithsonian Report for 1882," it is found in eastern Iowa and northern

Illinois, and appears to be the only form found in that region: hence it cannot be considered local.

Now, it is somewhat remarkable that nearly all the pipes of this form and the modifications thereof, ending in the modern form shown in Fig. 6, are found in a belt commencing in eastern Iowa, running thence through northern Illinois, eastern Indiana, southern Ohio, and thence bending south through Kanawha valley, and ending in western North Carolina. The first modification is seen in Fig. 8, and found in Ohio, the Kanawha valley, and North Carolina; the second, shown in Fig. 10, is found in Ohio and the Cherokee district; the third, shown in Fig. 5, is found in East Tennessee; and the last, shown in Fig. 6, is found in the North Carolina mounds.

Although specimens, chiefly of the first modification, have been discovered in New York and Massachusetts, it is not known that the "Monitor" or any of its manifest modifications prevailed, or was even in use, at any point south of the belt mentioned. Pipes in the form of birds and other animals are not uncommon, as may be seen by reference to Plate XXIII. of Jones's "Antiquities of the Southern Indians;" but the platform is a feature wholly unknown in the Gulf States or middle Tennessee, as are also the derivatives from it.

This fact stands in direct opposition to the theory that the mound-builders of Ohio fled southward across Kentucky and Tennessee, and became incorporated with the tribes of the Southern States, as it is scarcely possible that such sturdy smokers as they must have been, would have abandoned all at once their favorite pipe. The change, as it was in the other direction, would have been gradual. This evidence, however, has a very significant bearing on another point; for, if the testimony introduced justifies the theory advanced in this paper, then it is probable the Cherokees entered the immediate valley of the Mississippi from the north-west, striking it in the region of Iowa. This supposition is strongly corroborated, not only by the presence of the "Monitor" pipe and its derivatives along the belt designated, but also by the structure and contents of many of the mounds found along the Mississippi in the region of western Iowa and eastern Illinois. So striking is this resemblance, that it has been remarked by explorers whose opinions could not have been biased by this theory.

Mr. William McAdams, in an address to the American Association for the Advancement of Science, remarks that "mounds such as are here described, in the American bottoms and low lands of Illinois, are seldom found on the bluffs. On the rich bottom-lands of the Illinois River, within fifty miles of its mouth, I have seen great numbers

of them, and examined several. The people who built them were probably connected with the Ohio mound-builders, although in this vicinity they seem not to have many earthen embankments or walls enclosing areas of land, as is common in Ohio. Their manner of burial was similar to the Ohio mound-builders, however, and in this particular they had customs similar to mound-builders of Europe." Two mounds in Calhoun County, Ill., one of which was opened by Mr. McAdams and the other by one of the Bureau assistants, presented the clay mass in the regular form of the Ohio "altar." But what is strange, though not without parallel, is the fact that we find the structure and contents of some of the eastern Iowa mounds similar to what is seen in the Cherokee district of North Carolina and East Tennessee. Here, among other things, are seen the cubical piles or "altars" of unhewn stone with bones about them, precisely as found in some of the North Carolina burial-places, pottery bearing a strong resemblance to that of Ohio, and mounds with stone strata. A mound in Franklin County, Ind., described and figured by Mr. Homsher in the "Smithsonian Report for 1882," presents features strongly resembling those observed in tumuli attributed to the Cherokees. Here we see the rectangular heaps of cobblestones like those in the North Carolina mounds, and stratification and arrangement of skeletons as in the East Tennessee mounds, also the stone stratum observed in the Iowa works.

Having now traced the tribe back to the western boundary of the mound region, we are prepared to take a glance downward along the line of migration, bridging by deduction such breaks as appear in the testimony.

According to the data presented, we find them first on the west bank of the Mississippi, a tribe of comparatively limited numbers, slowly extending their settlements or shifting up or down the stream between the mouth of the Des Moines River and what is now the northern boundary of Iowa. If we may judge by their works, it would seem that it was necessary only at this northern point of their extension to fortify against enemies. A suggestion as to who these enemies were will be offered a little further on. It is impossible to give any satisfactory estimate of the length of time they occupied this locality; it was long enough, however, for them to acquire certain peculiar customs, some of which were not wholly dropped until they came into contact with the whites many centuries later. It is possible that here they began to build mounds, but explorations westward of this area have not been carried on to a sufficient extent to speak with certainty on this point. It was here, no doubt, that the platform pipe with animal figures came into use. The ornamentation of their pottery, and the forms of their vessels, suggest the possibility of contact or intercourse with southern mound-building tribes. There is also abundance of evidence that they had acquired the art of manufacturing cloth, and were acquainted with copper. The evident admixture, however, in these mounds, by intrusive burial, of articles of more recent times with those of the original burials, renders it somewhat difficult to decide positively as to the advance made in art by this people while residing in this locality.

After passing to the east side of the river, it appears that they moved some distance farther to the south, their utmost limits in this direction being in Calhoun County, Ill. The

reason for this may have been the presence of the same enemies who opposed their northward movement on the opposite side of the river. Of course, without the knowledge of all the mound testimony, any attempt to descend into details of the movements of the tribe would carry us wholly into the realms of speculation.

All that the mounds teach us in regard thereto is the extent of the area occupied, and the encroachments of works of other types which may or may not be contemporaneous.

It is a fact perhaps worthy of notice, that, while the remains of the effigy-builders on the west side of the river reach but little south of the fortified point before alluded to, they are found on the Illinois side as far south as the latitude of Peoria.

Passing on eastward, we next find indications of their presence in eastern Indiana, whence it seems they gradually moved into central Ohio, finding, as we judge from some works along the southern border of their line of migration, some opposition. Their stay in this attractive region must have been long, and for most of the time a period of peace. The reasons for this conclusion are, first, the indications of the growth of the tribe, judging by the number of works and the statements in the Delaware tradition, which imply that it had spread northward near to the lakes; and, second, the localities of the defensive works, which indicate that their chief contest was with a northern foe. If the latter supposition be correct, it would seem to imply that until this contest they had not found it necessary to build defensive structures.

These, of course, are speculations, and only advanced as such; but there is one thing in relation to their removal from this region for which there appears to be historical, traditional, and mound testimony, and which has some bearing on the preceding suggestions. This is, that their departure was in separate bodies, and at intervals of considerable length.

That some were in their historic seat before the time of De Soto's expedition, and possibly as early as the thirteenth century, has been shown. On the other hand, we have the statement of Bishop Ettwein, in a communication made to Gen. Washington, that the last of them did not remove from the region of Ohio until about the year 1700. We also find in the mounds of Ohio indications of intercourse with people residing in the mountain region of North Carolina.

It has been objected, with some show of reason, that the theory advanced in this paper cannot be correct, because there are no such enclosures in North Carolina and East Tennessee as those in Ohio, because no true "Monitor" pipes have been found in the mountain section, and because no engraved shells have been found in the Ohio mounds. The first of these objections has already been alluded to; but we may add, that this people found themselves able, in their mountain fastnesses, to protect themselves against all their Indian foes without erecting artificial defences. The second objection, as we have already shown, is answered by a somewhat remarkable historical statement by Adair. When he speaks of pipes "full a span long, with the fore part commonly running out with a short peak, two or three fingers broad and a quarter of an inch thick, *on both sides of the bowl lengthwise*," he can refer to no other known pipe than the "Monitor," or the very slightly modified form with

straight base, found also in the Ohio mounds. As the author quoted wrote before any specimens had been unearthed from mounds, he must have seen in use that of which he speaks. This, we repeat, is somewhat remarkable, and forms a link connecting the Cherokees and mound-builders of Ohio sufficient to warrant the theory here advanced, were there no other evidences bearing on the question.

The fact that no engraved shells bearing designs like those found in North Carolina and Tennessee have been discovered in Ohio forms no objection to the theory. Arts and customs are not always ethnical or tribal: some are acquired by contact and intercourse with other tribes. The custom of carving and wearing these shell gorgets did not originate with the Cherokees, but was acquired by contact with other tribes, after they had reached their southern home.

These objections do not militate against the theory, which is established on too broad a basis of facts and resemblances to be set aside by its failure to account for all the discoveries made. Investigations in regard to the origin and use of these ancient monuments must be made chiefly by comparisons and deductions, as historical evidence is in most cases wanting, and absolute demonstration impossible.

Attention was called in the first part of the paper to the conclusion reached by linguists, that the language of this tribe belongs to the Huron-Iroquois family, thus necessitating the inference that we must look to the same locality for the origin of both. This throws a faint ray of light on the history of our tribe preceding their arrival on the banks of the Mississippi. But before attempting to follow this slender clew, attention is called to some general considerations drawn from a comprehensive study of the monuments of the mound section.

In entering upon a discussion of the routes by which the mound-builders came into this section, an examination of the general distribution of the prehistoric remains is necessary. At present we are concerned only with what may be considered the boundaries thereof. Although the data are not sufficient to determine these limits accurately, enough has been ascertained to indicate what will probably be found in the end to be true.

Limiting the consideration to what are usually classed as the genuine works of the mound-builders, the eastern boundary extends from central New York along the Appalachian range to Virginia, diverging thence south-eastward so as to strike the Atlantic coast in South Carolina. The Gulf coast, west of Florida, appears to be generally bare of mounds (with the exception of shell and refuse heaps) for some distance toward the interior. On the north, the lakes and Rainy River form a tolerably well defined border, but west of the source of the Mississippi there is a northward extension into Manitoba which has not been fully traced; yet the indications are that but few ancient works will be discovered north of the Assiniboin region. Most of the mounds of this section which have been explored appear to be somewhat recent, though others bear evidence of being contemporaneous with the works of Wisconsin. On the west the plains appear to form the boundary from North Dakota to Texas, a line of recent works along the Missouri River forming the only exception, so far as known.

The statement frequently made, that the works of the mound-builders continue across Texas into Mexico, appears

to be without any foundation; for up to the present time but few have been discovered south of Red River, except in the eastern part of Louisiana.

So far, therefore, as the facts ascertained are concerned, the distribution of the works of the mound-builders affords but little evidence on which to base a theory in regard to the lines along which the authors of these works entered the mound section. The exceptions, if any, are to be found in Florida and the North-west. But this statement must not be taken as indicative of a theory held by the writer, for he is not inclined to the opinion that the mound-building element, except possibly that of southern Florida, entered through this peninsula. Although he has reached no settled conclusion on this subject, he has been inclined to look more to the north-west and west for the lines of immigration than elsewhere, but freely confesses that he finds but little in the works along the border on which to base any theory on this subject.

While this is true considering the section as a whole in its relation to the other comprehensive archæological divisions of the continent, there are, on the other hand, decided indications of movements within the mound section.

The works of the effigy-mound district, confined chiefly to the southern half of Wisconsin and the immediately adjoining sections, are peculiar, and formed a puzzling factor to those holding the theory of one great nation of mound-builders. The study of these appears to lead all those who have devoted attention to them to the conviction that the more elaborate forms, are, as a rule, older than the simpler ones.

Following up the slight clew thus afforded, and using the faint rays of light thrown on the history of the builders by the distribution of the mounds, we are led to believe that their entrance into the district was most likely at its southwestern corner, about what is now the north-eastern part of Iowa, and that the area longest occupied was the southwestern portion of Wisconsin. The indications are, that they shifted back and forth between the Mississippi River and Lake Michigan, and finally made their exit at the north-western boundary of the State, a part going as far north as southern Manitoba. From there they at length passed southward into Dakota, where the mounds fade out, and the presence of the descendants of the builders—who, we are inclined to believe, pertain to the Dakotan stock—is indicated only by surface figures.

Another movement, traced by certain classes of works and vestiges of art which we ascribe to the ancestors of the Cherokees, was that already mentioned, extending from eastern Iowa through Illinois, Indiana, Ohio, and West Virginia, to the mountain region of North Carolina and East Tennessee.

A third line is indicated by certain types of prehistoric remains extending from Michigan, along the southern shore of Lake Erie, into New York; but nothing has been found in these remains by which to determine the direction of the movement. There is little doubt, however, that the works along this line are attributable to one or more tribes of the Huron Iroquois family.

Another class of works forms an irregular line extending from southern Illinois, through Kentucky and middle Tennessee, to the north-east corner of Georgia; the area of chief

occupation, and position of longest quietude, being that portion of the Cumberland valley in middle Tennessee. The works along this belt, which we attribute to the Shawnees, consist chiefly of stone graves of a particular type, and mounds; they fail, however, to give any satisfactory evidence as to the direction of the movement. Nevertheless there are, along portions of the line, some evidences of a shifting back and forth; and the minor vestiges of art prove beyond question that the authors were contemporaneous with the builders of the mounds of East Tennessee and North Carolina.

Although the banks of the Mississippi are lined with prehistoric monuments from Lake Pepin to the mouth of Red River, showing that this was a favorite section to the ancient inhabitants, yet a study of these remains does not give support to the theory that this great water highway was a line of migration during the mound-building age, except for short distances. It was, no doubt, a highway of traffic and war-parties, but the movements of tribes were across rather than up and down it. We do not assert this as a theory or simple deduction, but as a fact proven by the mounds, whatever may be the theory in regard to their origin or uses. The longest stretch, where those apparently the work of one people are found on one bank, is that from Dubuque to the mouth of the Des Moines. As we move up and down, we find repeated changes from one type to another. In addition to this, is the intermingling of other types, and indications in most places of successive occupation by different tribes. It is a very natural supposition that the people first reaching the bank of this broad stream, or of any of the other large streams of our country, would continue their course along it, but the mounds give no support to the theory.

A study of this subject ought to lead us to the proper conclusion, for it is evident that the natural condition of a mound-building people is one of permanency: hence their movements are governed largely by pressure from other tribes, and not by choice. No evidence has yet been found in the mounds pointing to the first-comers into the section. On the contrary, all the evidences of migration point at the same time to pressure or obstacles in one or more directions. For example: the mound-builders of Wisconsin must have found some obstacle which prevented them from continuing their course eastward around the southern end of Lake Michigan, while the pressure which drove them from the area they had occupied so long seems to have come from the north-east.

The singular course of the people who buried in the stone graves south of the Ohio, whether moving eastward or westward, can be explained only on the theory of the presence of other tribes to the north and south; and this is probably true, as has been suggested, in regard to the people who travelled from eastern Iowa to Ohio.

Indications of movements are found in other portions of the mound section, but those mentioned are all which have any immediate bearing on the subject under consideration at present.

Returning now to the point where we paused in our journey backward along the pathway of the Cherokees, the inquiry arises, "From what point, or along what line, did they come to their halting-place on the banks of the Missis-

issippi?" As has already been stated, it is now conceded by linguists that their language is an offshoot of the Huron-Iroquois family,—a relationship long ago surmised by Dr. Barton and Mr. Gallatin. We may therefore, in answer to the above inquiry, though in a somewhat broader sense than given, adopt the language of Mr. Horatio Hale in speaking of the more closely allied branches of this family: "There can be no doubt that their ancestors formed one body, and indeed dwelt at one time (as has been well said of the ancestors of the Indo-European populations), under one roof. There was a Huron-Iroquois 'family pair' from which all these tribes were descended. In what part of the world this ancestral household resided is a question which admits of no reply except from the merest conjecture." He adds, however, "that the evidence of language, so far as it has yet been examined, seems to show that the Huron clans were the older members of the group; and the clear and positive traditions of all the surviving tribes, Hurons, Iroquois, and Tuscaroras, point to the Lower St. Lawrence as the earliest known abode of their stock."

If the evidence presented in this paper be considered sufficient to justify the belief that the Cherokees entered the Ohio valley from the west, we are, then, forced to one of two conclusions, which may be stated briefly as follows: 1st, That this tribe, breaking away from the family in its eastern home, wandered westward, passing between Lake Superior and Lake Huron into what is now Wisconsin, and onward to the border of the plains, turning thence southward to the point on the banks of the Mississippi where we first find them; or, 2d (which is far more likely), the original stock was at one time in the distant past located in the region north-west of Lake Superior, and while here the Cherokees separated from their brethren, and moved southward to the banks of the Mississippi, while the latter, being pressed onward, moved eastward, north of the Lakes, to the banks of the St. Lawrence. If this supposition accords with what really was the direction of the movement, then it is highly probable, that, when they reached the Ottawa River, a portion followed down its course, while others turned southward into what is now Ontario, and were in that section when the Lenape appeared on the scene.

The first of these suppositions presents a movement so unlikely, though not entirely without a parallel in Indian history, that we feel constrained to reject it, so long as there is a theory consistent with the known data that is more simple and reasonable.

The evidence presented by Mr. Hale in the "Iroquois Book of Rites" leaves no doubt that the earliest known seat of the Huron-Iroquois family was on the Lower St. Lawrence; but it is scarcely presumable that their first appearance on the continent was in this eastern region. It is more likely that they had reached this point from some western section, and as they increased in numbers were forced to partially retrace their steps.

Although it is apparent that the authors of the ancient works east of the Rocky Mountains were substantially in the same culture state, and belong to the same race in the broad sense, yet there are some reasons for supposing (if we include the ancient works of New York under the general term "mounds") that the custom of building mounds origi-

nated independently in some two or three different sections. This is inferred from the fact that there appear to be at least three comprehensive classes of works: first, those of the Huron-Iroquois region; second, those of the Dakotan district; and, third, those of the southern section. These are not limited by ethnic lines, as the people who built the works along what we have designated the Cherokee and Shawnee belts probably derived the custom from the southern mound-builders.

The southern Dakotans, as the Quapaws and cognate tribes, also built mounds of the southern type. It is possible, however, that future discoveries in the north-west and south-west may throw additional light on these questions, and modify the views here advanced, which are based, as a matter of course, only on the data so far obtained.

The attempt to estimate the time that has elapsed since the arrival of the Cherokees on the banks of the Mississippi (assuming the theory advanced to be correct) or since their meeting with the Lenape must be almost wholly conjectural. Mr. Hale says the time which has elapsed "since the Tallegwi were overthrown" is variously estimated, but that the most probable conjecture places it at a period about a thousand years before the present day, which would carry it back to the ninth century. Basing the estimate on the traditional evidence, for mound evidence gives but little aid in this respect before contact with the whites, it would seem to be more nearly correct to place the event in the eleventh or twelfth century. How long they had remained in this region when the war with the Lenape occurred is a question that must be left wholly to conjecture until other data than those we now possess are obtained; but it must have been a stay of some centuries, during which, as before said, they had lived in comparative peace. There are some reasons for believing that during this time another tribe had pushed its way up the Ohio River to the region about the mouth of the Miami. It is even probable that bands had crossed to the north side of the Ohio, and established themselves along the banks of the two Miamis. These I am inclined to believe, as heretofore remarked, were Shawnees who probably entered the Mississippi valley after the advent of the Cherokees. There is some evidence, however, in this region, of the presence of another small tribe which must have been driven out or destroyed. The remains which indicate the presence of this tribe are peculiar stone heaps and stone graves. It is possible that the presence of other people in this part of the Ohio valley caused the Cherokees to retreat up the Kanawha instead of southward across Kentucky.

The importance archaeologically of the questions here discussed does not end with their bearing upon the history of a single tribe, for at almost every point there are side connections with other peoples. If it be admitted that the Cherokees were mound-builders down to the appearance of the white race on the continent, the mystery of the builders of our ancient monuments is virtually dispelled; for the lines which radiate from this point are so numerous and so far-reaching, that, when traced out to their utmost extent, the whole realm of mound-builders will have been traversed. This is a view of the subject which has not received due consideration on the part of those who admit that some of the works are attributable to Indians, yet claim that others are due to a different and more highly cultivated race. An

illustration by partially tracing one or two of these lines will serve to impress the reader with the importance of investigation in this direction.

Reference has already been made to the fact that engraved shells similar to those found in the mounds of North Carolina and East Tennessee have been discovered in stone graves of a particular type, and that stone graves of this type often occur in mounds assigned, even by disbelievers of the Indian theory, to the true mound-building age. As the designs on these shells are peculiar, it is reasonable to conclude that the builders of the two classes of works were contemporaneous, or that there was an overlapping to some extent chronologically. Following up this line, which is traceable by other indications than merely the form of the sepulchres in which the dead were buried, we are led in one direction to the banks of the Delaware, where, history and archaeology inform us, the Indians of that locality were burying their dead in tombs of the peculiar type mentioned, as late as the time of William Penn. It carries us in another direction, to southern Illinois, where links are found connecting unmistakably with the historic tribes of that section.

Going back to the Cumberland valley, the chief seat of these stone-grave builders, other lines start out which lead to the ancient works of south-eastern Missouri. Speaking of objects taken from "the peculiar stone graves of the Southern States," especially those of the Cumberland valley, Professor Putnam states that he has classed these "as belonging to the southern mound-builders, from the fact that the careful exploration of thousands of the graves, under the direction of the Museum, shows that their contents, including the human remains, are of the same character as those of the burial mounds in general, in the same region. . . . We have conclusive evidence, in the objects here arranged, that the stone-grave people of the south-west, and at least one group of the mound-builders, were one and the same people."

In another place he says, "Many of these carved disks of shell have been found in the graves and mounds of Tennessee and Missouri, and, with the identity of the associated pottery from the two localities, go far to prove the unity of the people, notwithstanding some slight differences in burial customs."

Although it is probable that Professor Putnam is not justified in concluding that the people of the two sections were tribally identical (if this be his meaning), yet the strong similarity in the forms, ornamentation, and character of the pottery leaves no doubt that they were contemporaneous, and, in consequence of contact or intercourse, had adopted in some respects similar customs.

Thus it is seen, that, commencing with the mounds of the Cherokee district, the connecting lines lead to the modern and non-mound-building tribes of the Delaware valley, to the historical tribes of Illinois, and to the veritable mound-builders of middle Tennessee and south-eastern Missouri. Nor do these complete the list of points to which the branches of this single diverging line lead us. As there are other diverging lines, it is apparent, that, when all have been traced out along their various branches, a large portion of the mound area will have been traversed.

This renders it highly probable that there was no manifest break in the mound-building age. It may have continued,

and probably did, for many centuries, but there is no satisfactory evidence found in the monuments that there were two distinct mound-building ages. On the contrary, the historical, traditional, and archæologic testimony is decidedly in favor of the theory that our prehistoric works are attributable to the Indian tribes found inhabiting this country at its discovery, and their ancestors.

CYRUS THOMAS.

NOTES AND NEWS.

SINCE the article on the Kiowa County meteorites was published (*Science*, June 13, 1890), we learn that another mass, weighing 219 pounds, has been found at Brenham Township, Kiowa County, Kan.

—We learn from *Nature* of June 12 that the measurement of the Rhone glacier in a comprehensive and systematic way has been carried on since 1874 by the Swiss Alpine Club, and the abundant data obtained will shortly be published in separate form. It appears that the glacier was in recession till 1888, but since last year it has been advancing.

—By the new law on education of 1891, Sloyd is made obligatory in all the schools of Norway. The Norwegian Government has invited Mr. Akkel Mikkelsen, director of the Danish Sloyd-training College, to give a course of instruction at Christiania to the teachers of all the training-colleges in Norway. The courses for Sloyd at Nääs, in Sweden, will be held from May 27 to July 8, from July 29 to Sept. 8, and from Nov. 4 to Dec. 15.

—The Appalachian Mountain Club has issued a special circular relating to the twenty-fifth field meeting, at the Deer Park Hotel, North Woodstock, N.H., July 1-8, and excursion to Randolph July 8-14. Further information may be obtained by addressing John Ritchie, jun., Box 2725, Boston, Mass., or J. Allen Crosby, 70 Boylston Street, Jamaica Plain, Mass. Members of the club who would be interested in a trip to the Dead River region, Maine, in September or October, visiting Mounts Abram Bigelow, Snow, and Parlin Pond Bald, are invited to communicate with R. B. Grover, 11 Durham Street, Boston, Mass.

—A noteworthy event in the movement for the higher education of women, as we learn from the *London Journal of Education*, was the laying of the foundation stone of the Janet Clarke Buildings at Trinity College, Melbourne, Australia, on March 17. In 1883, Trinity College authorities decided, with some misgivings, to admit women students to their lectures. The next step was the establishment of a collegiate home, and a house in the neighborhood of the college was rented as a residence for lady students. To put this home on a permanent basis, Lady Clarke promised a donation of £5,000, which will go far towards defraying the cost of the new building. Sir M. H. Davies has given £2,000 as the nucleus of an endowment fund. Miss Hensley, a former student of Newnham College, has been engaged by the council as lady principal of what will be the first Australian women's college.

—In the *Journal of the Bombay Natural History Society* (vol. iv. No. 3) Mr. E. Giles records a curious fact, which ought to have some interest for entomologists. In June, 1888, he was standing one morning in the porch of his house, when his attention was attracted by a large dragon-fly of a metallic blue color, about two inches and a half long, and with an extremely neat figure, who was cruising backwards and forwards in the porch in an earnest manner, that seemed to show he had some special object in view. Suddenly he alighted at the entrance of a small hole in the gravel, and began to dig vigorously, sending the dust in small showers behind him. "I watched him," says Mr. Giles, "with great attention; and after the lapse of about half a minute, when the dragon-fly was head and shoulders down the hole, a large and very fat cricket emerged like a bolted rabbit, and sprang several feet into the air. Then ensued a brisk contest of bounds and darts, the cricket springing from side to side and up and down, and the dragon-fly darting at him the moment he alighted. It was long odds on the dragon-fly, for the cricket was too fat to last, and his springs became slower and lower, till at last his ene-

my succeeded in pinning him by the neck. The dragon-fly appeared to bite the cricket, who, after a struggle or two, turned over on his back and lay motionless, either dead or temporarily senseless. The dragon-fly then, without any hesitation, seized him by the hind-legs, dragged him rapidly to the hole out of which he had dug him, entered himself, and pulled the cricket in after him, and then, emerging, scratched some sand over the hole and flew away; time for the whole transaction, say, three minutes."

—In a lecture on "Foam," Lord Rayleigh insisted that foaming liquids were essentially impure, for pure liquids will not foam. For instance: neither water nor alcohol can be raised into a froth, although a mixture of the two may be to a certain extent. The addition of gelatine to water in the proportion of 1 in 100,000 develops the foaming quality quite noticeably. Of course, the best-known foaming liquid is a solution of soap, such as the children use for blowing bubbles. A liquid foams when its films have a certain durability. In all liquids these films exist, since a bubble as it rises is covered with a thin film. Now, the most striking property of films is their tendency to contract, and they may be regarded as being in the condition of a stretched membrane, as of India-rubber, with the difference that the tendency to contract never ceases. An air-bubble will force the air back through the pipe, and a loop of silk floating on a film will be forced into a circle the moment the film inside it is ruptured. Oil forms a film on the surface of water, and covers it entirely, even if the mass of the oil be collected into drops. This is well shown by dropping a particle of oil on to a vessel of water lightly covered with sulphur flour. The sulphur will be immediately driven to the edge by the spreading film. The reason of this is that the tension of the water-air film is greater than the combined tensions of the water-oil and oil-air films, and consequently pulls out the oil-film. It is possible to reduce the surface tension of water by mixing it with various substances, such as ether and camphor. Camphor scrapings placed on the surface of pure water enter into vigorous movement, because the dissolved camphor diminishes the surface tension of the water; but, if the water be contaminated by the least quantity of oil or grease, the motion ceases. Lord Rayleigh made several experiments to find what thickness of oil-film would accomplish this: he found it to be about $1\frac{1}{2}$ -millionth of a millimetre. This thickness bears to an inch the same ratio that a second of time bears to half a year. Lord Rayleigh explains the calming action of oil on the sea as follows: as the waves advance, the surface has to submit to periodic extensions and contractions. At the crest of a wave the surface is compressed, while at the trough it is extended. So long as the water is pure, there is no force to oppose this; but, if the surface be contaminated, the contamination strongly resists the alternate stretching and contraction. It tends always, on the contrary, to spread itself uniformly, and the result is that the water refuses to lend itself to the motion which is required of it. The film of oil may be compared to an inextensible membrane floating on the surface of the water, and hampering its motion.

—The visit of the Iron and Steel Institute of Great Britain to the United States in the autumn is likely to be in every way most successful. There will be three different sets of meetings,—the meetings of the American Institute of Mining Engineers, which take place in New York on Sept. 29 and 30; the meetings of the Iron and Steel Institute of Great Britain, which take place in the same city on Oct. 1, 2, and 3; and the international meeting promoted jointly by those two societies, which will take place about the middle of October at Pittsburgh. The excursions which have been planned by the American reception committee, of which Mr. Andrew Carnegie is chairman, provide for about three thousand miles of free transportation through the United States. According to *Nature*, the principal excursions will take place to the iron ore and copper regions of Lake Superior; to Philadelphia, Harrisburg, and Chicago, where there are large iron and steel engineering works to be inspected; and to the new iron-making district of Alabama. About three hundred members of the Iron and Steel Institute and one hundred German iron-masters have intimated their intention of taking part in the meetings; and already many have booked passages in the Hamburg-American Company's

steamer "Normannia," leaving Southampton on Sept. 12. The meetings and excursions will last altogether over a month, and will practically embrace every point of interest in the United States within a distance of fifteen hundred miles of New York. Papers have been promised for the meetings by Sir Lowthian Bell, Sir Nathaniel Barnaby, Sir Henry Roscoe, and others. Among those who have intimated their intention of being present at the meetings are Sir James Kitson (president of the institute), Lord Edward Cavendish, Sir John Alleyne, Sir James Bain, Mr. Hingley, M.P. (president of the Iron Trade Association), Mr. Theodore Fry, M.P., Sir J. J. Jenkins, Sir Thomas Story, Mr. Windsor Richards, Mr. Snelus, F.R.S., and Mr. Edward P. Martin.

—We learn from the *Journal of Education* (London) that a model school has recently been built at Mannheim, Germany, at a cost of £45,000. It contains 42 school-rooms, 2 drawing-rooms, 2 singing-rooms, 2 rooms for manual instruction, and a gymnasium; further, a large hall, 2 private rooms, 2 sets of rooms for the servants, and 4 subterranean prisons. The latest hygienic improvements and precautions against fire have been introduced. Iron has been used instead of wood, except in the roof. The ceilings are all of beton. The floors are parquet floors laid in asphalt. The accumulation of dust and the development of bacteria are hereby minimized. Underground there are two bath-rooms, one for boys and one for girls, with a dressing-room for each; also a large dining-room where 700 poor children can be fed in winter. The number of children in the *Volksschule* at Mannheim has increased from 4,650 in 1880, to 9,220 in 1890.

—The next meeting of the American Society of Microscopists, instead of being held at Louisville, Ky., will be held at Detroit, Mich., Aug. 12 to 15 inclusive. The outlook for the meeting is most encouraging, from the papers already promised. The subjects for discussion are "Representation of the Society at the World's Fair, Chicago, 1893," to be opened by Ex-Gov. Jacob D. Cox, Cincinnati, O.; "Micrometry," by Professor William A. Rogers, Waterville, Me.; "Proposed Standing Committee on Medico-Legal Microscopy," by Professor Marshall D. Ewell, Chicago, Ill.; "Uniformity in Tube-Length," by Professor Simon H. Gage, Ithaca, N.Y.; "The Advisability of adding more Members to the Publication Committee," by Professor D. S. Kellicott, Columbus, O.; "Proposed New Constitution," by Dr. William J. Lewis, Hartford, Conn.; "The Advisability of meeting at Same Time and Place of the American Association for the Advancement of Science," by Professor W. H. Seaman, Washington, D.C.; "Advisability of sending Copies of the Publications to Some of the Great Colleges and Libraries of the World," by Dr. Lee H. Smith, Buffalo, N.Y.; and "Fees of Experts with the Microscope," by C. M. Vorce, Esq., Cleveland. The general session for the reading of papers will be held in the new building of the Detroit College of Medicine, corner of St. Antoine and Catherine Streets and Gratiot Avenue. The mayor of Detroit will deliver the address of welcome, to be followed by the response of the president of the society, George E. Fell of Buffalo, N.Y. On Wednesday the forenoon and afternoon sessions will be devoted to the reading and discussion of papers and special topics; and in the evening the president will deliver the annual address, the subject being "The Influence of Electricity on Protoplasm." Thursday forenoon will be devoted to the reading and discussion of papers and special topics; and the afternoon, to the various technological features of microscopy, as preparing, staining, mounting of specimens, section-cutting, manipulative methods, etc. These demonstrations will be conducted by experts in the different branches of work, and will form a valuable feature of the meeting. In the evening there will be an exhibition of microscopes and objects, popular in character, and tendered by the society to the citizens of Detroit. Friday will be given over to the reading of papers, discussions, etc., until 4 P.M., when, by invitation, the members and friends of the society will take a trip on the Detroit River, followed by an inspection of the laboratories of Park, Davis, & Co. The headquarters of the society will be at the Hotel Normandie, and the Russell House and Hotel Cadillac will also be open to the guests. Negotiations relating to reduced railroad fares have been in progress. Should they be successful, due notice will be given. The

local committee of Detroit will issue circulars relating to the working session and the exhibition. They will supply badges, and look after the general welfare of those attendant upon the convention.

—The January number of Flecheisen and Masius' *Neue Jahrbücher für Philologie und Pädagogik* contains a short but interesting report by E. Vogel on Spanish *Gymnasia*. The writer commences with a few details on the Spanish *Volksschule*. He says that elementary education is not compulsory, but that the *Volksschulen*, whether conducted by the municipality or the Church or other societies, are not so bad as might be expected. The Spanish child is unusually sharp, and, not being burdened with several alphabets or a complicated orthography, learns to read and write easily in a few months. After this, he makes some progress in arithmetic and geography, and other branches of instruction; while the German teacher is still laboring, in the sweat of his brow, "seine buben durch die disteln und dornen eines sogenannten lesebuchs zu lavieren." There are some establishments for higher elementary teaching; but these are little patronized, children being usually put out apprentices at the age of twelve. Secondary education is given in the *institutos*, organized some thirty years ago. The curriculum covers five years, with a very singular time-table: viz., First year, Latin and Spanish, 9 hours weekly; geography, 4½. Second year, Latin and Spanish, 9; Spanish history, 4½. Third year, rhetoric and poetic, 9; arithmetic and algebra, 9; history, 4½; French or English, 4½. Fourth year, geometry and trigonometry, 9; psychology, logic, and ethics, 9; French or English, 4½. Fifth year, physical science, 9; biology and hygiene, 9; agriculture, 9. The school-year is 37 weeks. The text-books are said to be good, all except those on Spanish grammar, the best of which is ludicrously incorrect and antiquated. The teachers lecture, but the boys cannot understand the words they are obliged to use. The leaving-examination is ridiculous; so much so, that a moderately clever boy can become "bachiller" at fourteen, and most boys do so at fifteen. The *instituto* is consequently, in popular opinion, "ein humbug." Mr. Vogel, with the true German belief in pedagogy, concludes his observations with the remark that "a good middle school would, in twenty-five years, make this talented nation one of the first in Europe."

—Professors F. W. Clarke and H. W. Wiley, representing committees appointed by the Chemical Society of Washington, the Chemical Section of the American Association for the Advancement of Science, and the Association of Official Agricultural Chemists, respectfully submit the following statement: During the past two years the formation of a national, or rather continental, chemical society has been much discussed. A committee, of which Professor A. B. Prescott was chairman, presented a report upon the subject at the last meeting of the American Association, and that report was in the main favorable. A new committee, however, was appointed to secure fuller information, and will report at the next meeting of the association, in August, 1890, at Indianapolis. A larger attendance of chemists is there expected. The plan which has so far been chiefly considered is in brief as follows: to organize a continental chemical society, representative of all North America, by affiliating together as far as possible existing local organizations; the society as a whole to hold an annual meeting at such time and place as may be agreed upon from year to year; while local sections, like the sections of the British Society for Chemical Industry, shall have their regular, frequent gatherings in as many scientific centres as possible, all publishing their work in one official journal. The opinions of chemists are sought as to whether they regard the project favorably; and, if modifications or objections occur to them, it is desired to have them formulated. Upon the basis of the replies, the committees named will prepare their reports to the organizations which they represent. Other existing societies, having appointed similar committees, may take action independently; if so, their views will be considered also, as it is desirable to secure the fullest co-operation among the chemists of America. Complete unity of action is essential to success. Replies should be addressed to Professor F. W. Clarke, United States Geological Survey, Washington, D.C.

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Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

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THE TORNADO: ESPY'S EXPERIMENTS.

THESE investigations of Espy upon what actions may be considered as taking place in the upper air, as has been already said, are of the highest importance, and demand a special consideration. A proper interpretation of his results will help us in all our studies and reasonings. One of the most serious difficulties that we shall encounter, however, is in the fact that in the open air we are not dealing with a limited confined space, but we have to do with unlimited space and a well-nigh frictionless medium. The apparatus which he used has been sufficiently described already. The earlier investigation with the nepheloscope was made without the use of a condensing syringe; and in this we are able to comprehend clearly just the action which took place, while in the later researches the results were quite complex. Mr. Espy first carried his jar into air the temperature of which was quite low, at freezing or below; and, after it had attained the temperature of its surroundings, the stop-cock was closed, and the jar was taken to a room with high temperature, 70° to 80°. The air inside was expanded by the heat, and the amount of this expansion was measured on the gauge. He then opened the

stop cock, and closed it at the moment the mercury reached a level in the gauge. The rising of the mercury in the gauge after explosion, he thought was due to the gradual heating of the air which had been cooled by the sudden expansion. In the same way the jar was left in a high temperature for a time; then the stop-cock was closed, and it was carried to a low temperature. In this case, of course, the mercury in the gauge had the opposite motion to that it had before. The same experiments were tried with both moist and dry air.

One of the more important results from these researches, Espy does not seem to have thought of, though it dimly foreshadowed the epoch-making experiments of Mayer and Joule, in England, on the mechanical equivalent of heat. It is plain that in this confined space used by Espy there must be a relation between the amount of rise or fall in temperature and the corresponding change in air-pressure under a constant volume, and this will enable us to determine the expansion of air per degree of heat applied. In moist air the average difference of temperature between the cold and warm room was 45°, and the rise of the gauge 2.97 inches; in moist air, going from a warm to a cold room, the fall in temperature was 45°, and the fall in the gauge 2.60 inches: while with dry air these quantities were 57° and 3.34 inches and 63° and 3.30 inches respectively. The amount of change per degree in the four cases was .066, .057, .059, and .052 of an inch, or a mean of .059 of an inch in all the cases. The reading of the barometer is not given; but, if we assume it to be 29.80 inches, we find that the increase of temperature required to double the pressure in the jar was not far from 505°,—a result which is remarkably close to the 490° found by the more careful and extended researches of others. We now see the important bearing of this first work on our studies. If we compress air 5 inches by the gauge, we would heat it 83°; and if 10 inches, 167°; and so on, provided no heat was lost or dissipated in the operation. We ought also to be able to calculate from the reading of the gauge, after any operation of either condensation or expansion, exactly how much the air was heated or cooled, provided always that no heat was lost or gained.

In the light of this interpretation, let us examine some of Espy's experiments. In one instance he compressed the air 10 inches. We may suppose that he waited long enough to allow the jar to attain the air temperature before explosion. After the explosion the gauge reading was 2.15 inches, which would indicate that the cooling was not far from 36°, provided the only influence on the gauge was through the rise of pressure consequent upon the heating of the air by surroundings. It would appear that the theoretical cooling from such an expansion should be much greater than this; and, in fact, we cannot reason or theorize upon this result in any way, without first learning the probable loss of heat during compression, and its gain during expansion, to and from the environment. Espy's nepheloscope was duplicated in its different parts, with the addition of a most delicate thermometer loaned by Professor Russell. This instrument has a bulb .06 of an inch in diameter and 1 inch in length, and would change one degree in from two to three seconds. It is plain, that, in observations with any degree of speed in change of temperature, any instrument will be liable to lag behind the existing temperature. This difficulty, how-

ever, may be partially avoided by conducting operations at variable rates of speed, because, if we obtain the same result with different rates, we can conclude that the lagging is inappreciable. Again: the amount of this lagging may be approximately computed by using two thermometers with different rates of lagging. Whatever may be this lagging, however, it is plain that it would be exactly the same in moist as in dry air, so that our comparative results will be entirely free from any error due to the instrument. In saturated air, moisture collects on the bulb; but this can make no difference, since in saturated air the dry and wet thermometers read alike.

Experiments.

On rapidly compressing the air and suddenly releasing it, the amount of rise and fall in temperature was the same, about 7° for 10 inches of compression. We shall be entirely within the limits of error if we assume the lagging to be 1° . Since the air at the side of the jar was at very nearly the air temperature, we can consider that the average heating and cooling of the whole air was not far from 4° . This shows what an enormous loss of heat was sustained by the air in compression to one-third its bulk. The theoretical heating should have been 163° , while the actual heating was one-fortieth of that. But the most important fact in this connection is that Espy, under the same conditions, found the cooling after expansion to be nine times that found above. Espy emphasizes the great necessity that exists in closing the stop-cock at the moment the mercury reaches a level, or at the exact moment when we may suppose the cooling by expansion is greatest. On repeating these experiments, it was a matter of great astonishment to find that the delay of a few seconds only in stopping the expansion, after the columns in the gauge were at the same level, almost entirely obliterated the subsequent rise. This would seem to show that heat from the environment had little or nothing to do with this rise, and this is an exact corroboration of the indication of the thermometer; for a rise of 4° , which was found, would represent less than .25 of an inch on the gauge. Does the mercury in the gauge reach a level before the air inside the jar is in equilibrium with the outside air? Professor Marvin has suggested that the momentum of the mercury in the latter part of the expansion would cause it to reach its level sooner than the air its equilibrium. On performing the experiment at different speeds of expansion, it was found that a definite relation existed between the rapidity of fall of the mercury and the subsequent rise after arresting the expansion. For example: the air each time was compressed to 400 millimetres, and expanded in 5, 10, and 20 seconds. The amount of rise in these cases was approximately 41, 21, and 12 millimetres respectively. It might be thought that this was due to the greater accession of heat to the air during the slower expansion (that is, the cooling would not become as great), but in all these cases the thermometer indicated the *same* cooling at the end. It must also be plain that this effectually disposes of the question of lagging, as suggested above. The evidence is cumulative and conclusive, that the rise noted by Espy was not due to a heating, from outside, of the air cooled by expansion; and his whole theory regarding the difference in cooling, of dry and moist air, falls to the ground.

As regards the fact that there is only an exceedingly slight rise after waiting a few seconds, Professor Seaman has suggested that the air may be heated in these few seconds, and therefore there is no rise. But it takes time to heat the air under these conditions, and in these few seconds the amount of heating is exceedingly slight: in fact, this one thing is a strong argument against the view that the rise noted after expansion is due to heat; for the rise is very rapid, and is accomplished in a few seconds. Still another point is to be noted: by making the compression to 400 millimetres very rapid (that is, in 10 seconds), and then expanding in 5, 10, or 20 seconds, we have heated and cooled our air by very nearly the same amount, and it has come back to just a degree or two below the outside air temperature; so that the subsequent rise cannot be due to the accession of heat from outside. There is an exceedingly interesting matter right here that I leave for physicists to consider. We are told that the only way in which air can lose its heat is by performing work. Now, is it possible for us to consider that the amount of work done in compressing the air to 400 millimetres is exactly counterbalanced by the work done by the air in forcing aside the outside air as it rushes out of the jar? It would seem as though the former must be a thousand or more times greater than the latter, if we take account of all the circumstances. One more experiment was tried to determine the cause of the rise in the gauge after explosion. If this rise were due to the behavior of the gauge, rather than to outside heat, we ought to be able to obtain it at any moment after expansion, and long before any marked cooling had taken place. When the expansion was arrested after one or two seconds, there was a marked rise in the gauge. This arrest must have been long before the cooling could possibly have brought the air to the outside temperature, for the just previous compression had heated it 4° above the air, and the expansion could not cool it down before 5 seconds had elapsed. Whatever may have been the cause of this rise, there is one point about which there is not the slightest doubt, and this is the principal point that we are to consider. Under all conditions of slow or rapid compression and expansion, the final cooling after explosion was almost identically the same, whether moist or dry air were used. This was determined by the thermometer; and in this experiment it must be admitted that the lagging of the thermometer had no influence, for it would be precisely the same in both moist and dry air. The rise of the gauge after explosion with dry air was slightly greater than with moist air, but this may have been due to a difference in the whirls which the explosion always produced inside the jar. It seems almost incredible that this fatal slip should have occurred at such an extremely critical point in Espy's work; and I am impressed with the conclusion thus reached, not so much by my interpretation of Espy's doubtful results, but far more because the two sets of experiments dovetail into each other so perfectly, and the one serves as a check on the other.

It is not a little remarkable that we have obtained somewhat the same result as this by another method of reasoning. The condensation of the moisture or the appearance of the cloud, even in thoroughly saturated air, is exceedingly evanescent in a jar of this kind. It is next to impossible, except with very high compression (15 to 20 inches), to get

a particle of mist to settle to the bottom. Under the compressions employed by Espy, the cloud or mist entirely disappears in a few seconds, and not an atom of moisture reaches the bottom of the jar. Suppose, now, that, at the instant of expansion, latent heat were liberated by the formation of the cloud, which would prevent a further cooling. It is very plain that it would be used up immediately in the evaporation of the cloud; and the disappearance of the mist proves that the sensible heat has again become latent, and can have absolutely no effect in expanding the air or in causing a final higher gauge reading, as Espy thought.

A note should be made of the condition of Espy's moist air. The presence of a haze or cloud is no evidence of saturated air, for such cloud has been produced in air having only two per cent of moisture. When air is pumped in from the room, it has an enormous number of dust-particles in it, and these give the semblance of fog on sudden expansion. Espy tried to saturate his air by putting a little water into his jar, but it is certain that this expedient would be of little or no effect. Bubbling air through three inches of water will not saturate it, and it was found that nearly all expedients failed to do so. The only satisfactory saturation could be effected by passing the air through a bottle full of small pieces of sponge saturated with water. While we cannot think that Espy's air was saturated, yet it is certain that the experiments in 1889 were with saturated air, and hence must have shown a difference between dry and moist air, if any could have done so. The delay of several days in some of Espy's experiments after compression before explosion should have served, and probably did serve, to increase the moisture in the air, and not to diminish it, as he thought, and as his researches seemed to indicate. It might be thought essential, in order that this question may be settled beyond all doubt, that there be some explanation of Espy's results showing a slightly greater rise in the gauge after expanding dry air than when moist or partly moist air was used. Undoubtedly, if all the conditions were known, the difference could be easily explained. It is absolutely certain that it was not due to any latent caloric or elasticity that was given out by the moist air.

I think this discussion will enable us to reason more or less effectively as to what are the probable heating and cooling effects in the free atmosphere from descending or ascending currents, and the resultant liberation or production of energy. It is well known that the most perfect locomotive makes use of only five to ten per cent of the total energy developed. We have just seen, that in condensing air to 10 inches, instead of obtaining an increase of temperature of 163° , as theory seems to indicate, we have barely reached 4° , or one-fortieth of the theoretical amount. It is plain that this is due to the loss of heat into the environment of the air. Suppose, now, we take away this confining jar; suppose we make steam in the open air instead of our locomotive boiler; or suppose, instead of trying to compress air in our jar, we had the total horse and steam power of the whole earth engaged in compressing the free air by forcing it through syringes or force-pumps into the atmosphere. What would be the result? The utter absurdity of all this is most plainly manifest, but is it any more so than the attempt at developing effective energy in the free air, as has been theoretically accomplished by some? If there is this

enormous dissipation of heat under conditions which we can control, must there not be a very much greater dissipation of heat in all out-doors? Is it not highly probable that many of the theoretical deductions find their only shadow of support in the fact that the assumptions call for a perfect engine without loss of a particle of energy? Has theoretical meteorology ever produced even a single essential effective element or part of this perfect engine? If the considerations herein set forth are borne out by subsequent researches, we must most certainly come to the conclusion that thus far theoretical meteorology has not had a single well-supported fact on which to base its profoundest theories of tornado generation and movement. Professor Wild of St. Petersburg has well said, "Without exact and satisfactory data, meteorology cannot develop as a science, but will be, as heretofore, mainly a tumbling-ground for vague speculations and dilettanti investigations." H. A. HAZEN.

LETTERS TO THE EDITOR.

*** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The editor will be glad to publish any queries consonant with the character of the journal.

On request, twenty copies of the number containing his communication will be furnished free to any correspondent.

Ohio Meteorites.

UNDER date of June 13, Mr. George F. Kunz, in an article in *Science* upon meteorites, mentions two copper ear-rings found by myself in an Ohio mound as partly composed of meteoric iron. Mr. Kunz is in error as to the locality of the find. It was made at Frankfort, Ross County, O., and not in the neighborhood of Fort Ancient, as stated in the article.

The ear-rings are coated with a heavy plate of the iron, and are splendidly preserved, the iron having resisted atmospheric agencies remarkably well. It is slightly corroded in one place only.

The state of preservation is due to the placing of the objects in a layer of fine, dry gravel by the builders of the mound. The nearest skeleton was distant five feet, and the ear-rings did not accompany any remains. However, there were three copper hatchets placed alongside these ear-rings, and five other spoons or ear-rings, too; but these latter were not covered with meteoric iron, or any other substance. The mound was examined in April, 1889.

WARREN K. MOOREHEAD.

Xenia, O., June 18.

Vertical Components of Motion in Cyclones and Anticyclones.

IN saying that there is an ascending component of motion in cyclonic areas, and a descending component in anticyclones (*Science*, May 30), I meant that the winds in these areas of low and high pressure do not move horizontally, but obliquely upwards or downwards. The evidence of this has been presented and discussed by Loomis, in his "Contributions to Meteorology," in the *American Journal of Science*; and an abstract of these has been prepared by Clayton for the *American Meteorological Journal*. Hann and others have also discussed the matter. If Mr. Velschow, who makes inquiry on this point in *Science*, June 20, is not already acquainted with the writings of these authors, a reference to them would perhaps satisfy him. W. M. DAVIS.

Cambridge, Mass., June 21.

BOOK-REVIEWS.

Locke. By ALEXANDER CAMPBELL FRASER. Philadelphia, Lipincott. 16°. \$1.25.

THIS the latest volume of Blackwood's "Philosophical Classics" is one of the best of the series. It opens with a quite full account of Locke's early life and education, with brief sketches of his family and the various persons with whom he came in contact in those years, and by whom he may be supposed to have been influenced. It then recounts his entrance into political life, and the

various vicissitudes he experienced in consequence of the frequent changes of government, culminating in a ten-years' exile in Holland. These ten years were quite probably the most important in his whole life; for it was chiefly during this time that he thought out and composed his "Essay on the Human Understanding," and also some of his most important political treatises. The later events of his life, together with the history of his various works, are related by Professor Fraser with care, and with as much fullness as most readers will desire.

The account of Locke's life, however, is kept subordinate to the analysis and criticism of his philosophy,—a task which Professor Fraser has performed with great clearness and philosophical acumen. He remarks in his preface how great has been the influence of Locke's "Essay" upon subsequent thought, and that it "seems in excess of the author's speculative depth and subtlety or grandeur of character,—a remark with which most readers of the work at the present day are likely to agree. Professor Fraser shows, however, in another place, to what this influence is really due. Locke was the first thinker to place at the very portal of philosophy the question as to the "origin, certainty, and extent of human knowledge;" and, though he failed to answer the question himself, it has been recognized ever since as the main problem in human thought. When Professor Fraser comes to inquire why it was that Locke failed to solve the problem, he shows plainly that it was due to an insufficient comprehension of the intuitions of reason and of their philosophical importance. Locke did not deny their existence,—on the contrary, he expressly recognized their truth and self evidence,—but he assigned them a subordinate place in his scheme, and therefore failed to give a satisfactory account of our ideas of substance, infinity, causation, and others, which cannot be derived from external or internal sense. Professor Fraser's discussion of this point is very able; and all who wish to understand Locke's work, and his place in the history of philosophy, will do well to read this book.

Russia: its People and its Literature. By EMILIA PARDO BAZÁN. Tr. by Fanny Hale Gardiner. Chicago, McClurg & Co. 16°. \$1.25.

THE object of this work is to give an account of the present state of society and opinion in Russia, with a more particular examination of the works of the Russian novelists. Señora Bazán tells us at the outset that she is not acquainted with the Russian language; but she has read largely of the works in other languages that treat of Russia, together with all the translations from Russian literature that have appeared. She has also associated considerably with Russian authors and revolutionists in Paris, and by all these means has obtained materials for an interesting book. Of course, in a small book prepared in this way, we cannot expect any thing specially new or original; but the reader will find in it a clear and instructive delineation of the more important phases of Russian life and literature as the authoress understands them. She begins by briefly noting the leading points in Russian history, and then gives us a study of nihilism, which to our mind is the most interesting part of the book; while the rest of her remarks relate mainly to the new school of Russian novelists, beginning with Gogol, and ending with Tolstoi. Nihilism, she thinks, as others have thought, is in great part the product of the atheistical and pessimistic philosophy of Germany, though political discontent has had a share in forming it; and she shows clearly that it is confined to the more active and educated classes, the peasantry and workingmen generally showing thus far no sympathy with it. The characteristics of Russian fiction are attributed partly to nihilism, and partly to the spirit of "realism" which pervades all the fiction of the age. After spending several years, however, in the study of her subject, Señora Bazán confesses herself somewhat baffled, and ends with the remark, "Russia is an enigma; let those solve it who can—I could not."

Pestalozzi, his Life and Work. By ROGER DE GUIMPS. Tr. by J. Russell. (International Education Series.) New York, Appleton. 12°. \$1.50.

ABOUT a year ago we had occasion to notice a translation of De Guimps's "Life of Pestalozzi," by Miss Crombie, and we are now

favoring with another by a different hand. Of the two, the rendering by Mr. Russell seems to us the best. We have not the French original at hand to test the accuracy of the work, but this is vouched for by Rev. R. H. Quick, who writes a brief introduction; and the translation reads like an original composition in English, thus making an interesting book. Moreover, it is complete, the narrative being given entire, with very copious extracts from Pestalozzi's own writings. It is therefore the best account of his life and work to be found in English, and is well worthy of a place in the series to which it belongs.

Of Pestalozzi himself we have perhaps said enough in former articles; but we may cite a few remarks by Mr. W. T. Harris in the "Editor's Preface," which he contributes to the volume. He holds, and rightly, that the Swiss educator's importance consists not so much in his method of teaching as in his ardent desire for the education and elevation of the poorer classes, who, previous to his time, had had virtually no education at all. According to Mr. Harris, "he is the first teacher to announce convincingly the doctrine that all people should be educated,"—a doctrine now held and more or less effectively practised in all civilized countries. It was to this end that all his labors were directed, and he had thus the honor of leading the movement for universal education. Of his method of teaching, Mr. Harris does not speak so highly, believing in particular that he laid too much stress on the mere training of the senses, and too little on the development of the thinking faculty. With these views we agree; and we cannot help adding, that, in our opinion, an efficient practical method was just what Pestalozzi lacked, the failure of all his educational experiments pointing strongly to this conclusion.

AMONG THE PUBLISHERS.

IN the *Atlantic* for July, Professor Shaler writes about "Science and the African Problem." Mr. Albert Bushnell Hart's paper on "The Status of Athletics in American Colleges" may be called "timely."

—Messrs. Ginn & Co. announce a revised edition of "Our Government," by Jesse Macy, professor of constitutional history and political economy in Iowa College.

—Edward Heron-Allen, the well-known expert in palmistry, has an article upon "The Cheiromancy of To-Day" in *Lippincott's Monthly Magazine* for July.

—The July number of the *Contemporary Review*, issued in this country in the original English form by the Leonard Scott Publication Company, New York, will contain a paper by Edward Bellamy.

—Any of our readers who are planning a trip to Europe should look at the "Guide to Europe" published by Houghton, Mifflin, & Co., and edited by the well-known Stoddard. The book is of convenient size, is well made for its special purpose, and contains just the information required by the vacation tourist. A new edition appears each year.

—The contents of the first number of the fourth volume of the *Journal of Morphology* (Boston, Ginn & Co.) are as follows: "The Origin of the Cerebral Cortex and the Homologies of the Optic Lobe Layers in the Lower Vertebrates," by Isaac Nakagawa, B.Sc., Princeton College; "The Skeletal Anatomy of Amphiuma during its Earlier Stages," by O. P. Hay; "The Segmentation of the Primitive Vertebrate Brain," by Charles F. W. McClure, fellow in biology at Princeton; "The Life History of the Formed Elements of the Blood, especially the Red Blood Corpuscles," and "Observations upon the Occurrence, Structure, and Function of the Giant Cells of the Marrow," by W. H. Howell, Ph.D., lecturer in physiology and histology, University of Michigan.

—Some weeks ago we noticed the proposed series of popular science books to be published in this country by Macmillan. The first of this series, which appears under the general title "Science in Plain Language," is by William Durham, a fellow of the Royal Society of Edinburgh, and consists of a number of short essays on evolution, antiquity of man, bacteria, the basis of life, ancient lake dwellings, etc. The titles would lead one to suppose the book to be of a somewhat disjointed character, but the author's aim was to

show a connection between all the subjects, illustrating the principle of evolution. The volume proposed to follow in this series will contain various papers on astronomy and physics, including "The Sun and Solar Energy," "The Moon," "Weighing the Sun and Moon," "Size and Mass of the Earth," "Planet Worlds and Suns," "Fixed and Variable Stars," "Star Clusters, Nebulae, and Comets," "Contents of Space," "Formation of the Heavenly Bodies," "Tides," "Light," "The Spectroscope," etc.

—Two of the recent publications of the Johns Hopkins University may interest some of our readers. One is on "The Study of History in Germany and France," by Paul Frédéricq of the University of Ghent, translated by Henrietta Leonard, and gives a somewhat minute account of the methods now pursued in teaching history in the universities of Germany and in the various higher schools in Paris. The historical courses in the German Universities are of two kinds, theoretical and practical, of which the former are like those in our own colleges, while the latter are intended to teach the student how to investigate and criticise the original authorities. It is these practical courses, as pursued in the historical seminaries, that M. Frédéricq most esteems; and he devotes many pages to an account of the way they are carried on, the students doing most of the work, and the teacher making suggestions and criticisms. Some foreign observers have thought that this mode of investigating history was degenerating into a mere criticism of texts and study of trifles; but M. Frédéricq thinks otherwise, though he admits that it might do so. The French historical courses in general he esteems less highly, but speaks with enthusiasm of those at the Practical School for Advanced Study (L'École Pratique des hautes études), founded in Paris a few years since, and which resemble to some extent those of the German universities. On the whole, M. Frédéricq's monograph, though too minute for most readers, is well prepared, and will doubtless be suggestive to American educators. The other pamphlet to which we alluded is "Notes on the Progress of the Colored People of Maryland since the War," by J. R. Brackett. This author had previously published an account of the negroes and of slavery in Maryland before the war, to which the present

work is therefore a supplement. He speaks first of the political action of the negroes, which, in his opinion, has not helped them much, and then goes on to state what they have done in accumulating property and otherwise improving their condition. He reports, that, according to the best information obtainable, not more than two thousand of the Maryland negroes own any property, though the number of negroes in the State is over two hundred thousand. Considerable difficulty has been experienced by them in gaining admittance to the professions of law, medicine, and teaching; but they have finally succeeded in all these cases. Some prejudice and caste feeling still prevails; but, on the whole, the status of the negro in Maryland seems to be improving as fast as could reasonably have been expected.

—The Shakespeare Society of New York announces that it will immediately resume its publications (temporarily discontinued, pending the establishment of "The Bankside Shakespeare") with a second series, to consist of unexpurgated reprints of the Old English Miracle Plays, Mysteries, and Moralities, as illustrating the growth of the drama up to Shakespeare, besides the least known and edited English plays contemporary with Shakespeare's own work. This second series will discard the black and gold cover and 16mo. page heretofore used, and hereafter all of the society's publications will be issued in "Bankside" style, in the best work of the Riverside Press; laid paper, boards, parchment backs, 8vo.; uniform with "The Bankside Shakespeare." Two hundred and fifty copies of this series only will be printed, and the type will then be distributed, not to be reset under any circumstances. These impressions will be sold at \$2.50 per volume, payable on delivery, plus postage. No. 1 of this second series will be "Lacke Drvms Entertainment, Or The Comedie of Pasqvil and Katherine. as it hath beene sundry times plaid by the Children of Powles. Newly corrected, London, printed by W. Stansby, for Philip Knight, and are to be sold at his shop in Chancery-Lane over against the Roles. 1616. (With notes, and Introduction touching the origin, growth and decadence of the Children's Companies.)" Address L. L. Lawrence, clerk Publication Committee, N. Y. S. S., 21 Park Row, New York City.

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—Welch, Fracker Company have published a work entitled "In Western Levant," by Francis C. Sessions, illustrated by Henry W. Hall. It is a record of travel in Spain, Morocco, Algeria, and Tunis, with brief descriptions of the most noted cities and architectural works, as well as of the character and habits of the people. There is nothing of much scientific interest in the book, the author having evidently sought for entertainment during his travels rather than for information; and the work is marred by a too florid rhetoric. Nevertheless those who are fond of books of travel will find many items of interest in this one. It is printed on good paper, suitable for the illustrations, which are pleasing.

—The fifth volume of the new edition of "Chambers's Encyclopædia" has been issued, and deals with the various topics from "Friday" to "Humanitarians." The scientific articles are quite numerous and important. Professor Geikie treats of geology; John S. Keltie, of geography; J. S. Mackay, of geometry; P. G. Tait, of heat; J. Arthur Thompson, of heredity; and there are many other articles that would demand notice in a minute survey of the work. Among the articles of a political and historical character are those on Germany, Great Britain, Holland, and Ancient Greece; while Charles I. Elton, M. P., contributes a paper of several pages length, on government. Mr. Gladstone furnishes the article on Homer, while Justin M'Carthy sketches the life of Gladstone himself. Other biographical papers are those on Gen. Grant, written by Gen. Wilson; on Goethe, by Professor Dowden; and those on Grote, Hooker, and Hegel; while Henry George contributes a sketch of himself. This encyclopædia is, in our opinion, the best for the mass of reading and thinking men. The "Britannica," of course, gives a much larger amount of information on the details of the subjects treated; but then its articles are often too elaborate for a busy man to read, yet not elaborate enough for thorough students of their respective subjects. Besides, Chambers's has now the advantage of being the latest work of the kind in the market. It is published in this country, in

agreement with Messrs. Chambers, by the J. B. Lippincott Company, Philadelphia.

—We have received a small pamphlet entitled "An Open Letter to Hon. Edward M. Paxson, Chief Justice of Pennsylvania." It is written by Richard B. Westbrook, who describes himself as both a bachelor of law and a doctor of divinity, and is a criticism of certain remarks of Chief-Justice Paxson in an address before the law school of the University of Pennsylvania. In that address Judge Paxson had affirmed that the law of Sinai was "the first law of which we have any knowledge," and that Moses was "the greatest statesman and law-giver the world has ever produced." These statements Mr. Westbrook disputes, and gives in an argument of moderate length very good reasons for doing so. He has no difficulty in showing that Egypt and some other countries had elaborate systems of law long before the date assigned to Moses; and he also shows, on the grounds now universally accepted by biblical scholars, that the legislation attributed to Moses is, for the most part at least, of very much later date. Exceptions may be taken to some of his statements; but, on the whole, every one whose eyes are open to the results of historical investigation will agree that he has proved his case. The pamphlet is published for the author by the J. B. Lippincott Company, Philadelphia.

—The Exchange Printing Company, 47 Broad Street, New York, has issued a book entitled "How to preserve Health," by Louis Barkan, M.D. The claim is made that this work is published with the purpose of bringing to public attention the results of the latest medical investigations. The objection to the author's plan that naturally occurs to one reading the pages is that a little knowledge is a dangerous thing, and that the author has gone too far in recommending certain courses of treatment for ailing humanity which shall be resorted to without consultation with a competent physician.

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The author of this book was for some years president of the New York Microscopical Society, and in this volume he sets forth his views on the spontaneous generation theory and its relation to the general theory of evolution, and on protoplasm and the cell doctrine.

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A YOUNG MAN, graduate from an American College, who has studied a year in Germany, and is now studying in Paris, would like professorship in chemistry. References from some of the best chemists. Address CHARLES E. LINEBARGER, Post-Restante, Paris, France.

WANTED.—An opportunity to study qualitative analysis in or near New York City during the summer. W. J. L., 130 Spring st., Sing Sing, N. Y.

ASSAYER.—Wanted position as above, has had three years' practical experience in a London firm of assayers to the Bank of England, Royal Mint, etc., etc. Thorough knowledge of bullion assaying, and of gold, silver and lead ores. I. FRED. JOHNSON, Northgate Brewery, Canterbury England.

AN OHIO STATE UNIVERSITY graduate desires a position for next year as laboratory assistant or instructor in chemistry and physics. Three years' special preparation for such work. Two years' experience in teaching. References as to character and scholarship. Address C. S. ARNOLD, O. S. U., Columbus, O.

A GRADUATE of Princeton, for several years university student and Fellow in Biology, desires a position either to teach biology or as assistant in a biological laboratory. Would prefer the latter and be satisfied with a moderate salary if the position afforded time for the prosecution of original research. Address, O. S., BOX 86, Princeton, N. J.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 47 Lafayette Place, New York.]

For exchange—14 volumes (1883-1889) American Journal of Science, 10 volumes (1880-1889) American Naturalist, 21 volumes (1879-1890) English Mechanic, all in good condition for binding; also, Morris Typewriter. Wants first-class microscope, camera, chemical or physical apparatus. Address, with full particulars, E. R. Chadbourn, Lewiston, Maine.

Wanted.—To exchange land and fresh-water mollusca, (principally *Helices Achatinellae*, Clausilidae and Limnaeae,) for those not in my collection. Lists exchanged. Address E. H. White, Box 200, Astoria, Or.

To exchange for other books: Meek's Invertebrate Paleontology, Cope's Cretaceo us Vertebrata, Leidy's Extinct Vertebrate Fauna, Lesquereux Cretaceous Flora. All being volumes of the Hayden Final Reports. Address, giving lists, T. N. Glover, Suffern, N. Y.

Meteorites.—Mr. George F. Kunz, 11 to 15 Union Square, New York, or Hoboken, N. J., will buy or give in exchange for whole or parts of meteorites. Whole ones, undescribed ones, and entire falls especially desired.

Wanted—To furnish roots of *Dodecatheon Meadia*, *Sarracenia purpurea*, and other wild flowers, native of Southern Wisconsin, in quantities. D. E. Willard, Curator of Museum, Albion Academy, Albion, Wis.

I have a number of duplicates of microscopic slides, mostly botanical, which I would like to exchange for others not now in my collection. Send list of what you have to exchange and get my list. S. R. Thompson, New Wilmington, Pa.